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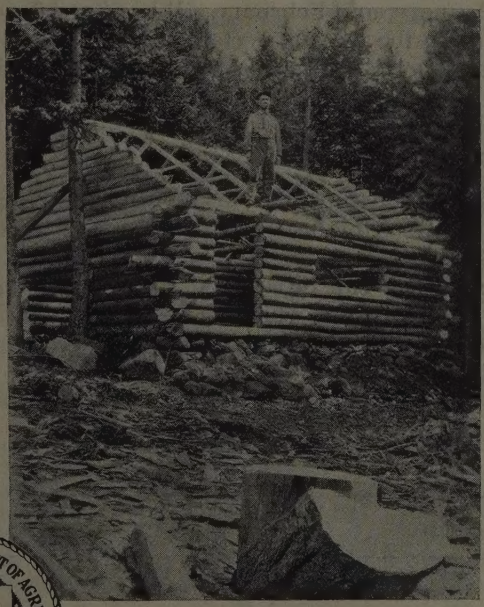
PROTECTION

OF LOG CABINS, RUSTIC WORK AND UNSEASONED WOOD *from* INJURIOUS INSECTS



INSECTS cause considerable damage to the unbarked logs of the principal woods used in the construction of log cabins, rustic woodwork, and certain other unseasoned products. This damage, which varies from the making of numerous holes in the bark to the complete destruction of the sapwood and heartwood, causes annoyance and unsightly condition of the material as well as large financial loss. Some of the insects which cause the damage are active nearly every month of the year except December, January, and February. It has been found that by cutting the trees at certain seasons and by treating the wood with preventive and remedial substances practically all such insect damage can be prevented or checked. This bulletin tells how it can be done.

Although the information contained herein applies specifically to the insects which occur in the eastern and southern parts of the United States, the principles set forth can be applied equally well to problems of this nature which occur in the country as a whole, provided due allowance is made for individual differences in insect and tree species and also in the time of flight of the beetles because of differences in climate.

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PROTECTION OF LOG CABINS, RUSTIC WORK, AND UNSEASONED WOOD FROM INJURIOUS INSECTS

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DURING the last few years there has been an increasing demand for information on the protection of log cabins and rustic work from injurious insects. This is largely due to the popularizing of National and State forests and parks for recreational purposes, as a result of which many rustic bridges, benches, and log cabins have been constructed in such places. But it is also due to the increased building of rustic summer homes and arbors on private woodlands and estates. Wood with the bark still on is subject to injury by many kinds of beetles; therefore manufacturers, as well as the users, of rustic furniture constantly request advice. In addition, concerns requiring small raw poles from which to manufacture certain finished products, such as shuttle blocks, mallets, and mauls, often suffer severe losses and call for advice.

HOW BEETLES AND GRUBS DAMAGE UNSEASONED WOOD

Woods cut at certain seasons of the year are subject to attack by beetles which fill the bark with holes, thus causing sawdustlike borings to fall out and lodge on the wood. The larvae, or grubs, of wood-boring beetles mine the inner bark, causing the bark to loosen and fall off, and they bore into the sapwood and sometimes the heartwood of logs, making large holes and often reducing them almost to dust within a few months, before the wood becomes well seasoned.

WOODS PRINCIPALLY USED FOR CABINS, RUSTIC WORK, AND CERTAIN WOOD PRODUCTS

The woods mainly used in the construction of log cabins and the rustic work in summer homes, furniture, and fences are spruce, fir, hemlock, tamarack, cedar, juniper, pine, birch, poplar, hickory, and

oak. The selection of the wood to be used for these purposes is often determined to a large extent by the local supply. Hickory, ash, dogwood, and persimmon, which are used in the manufacture of shuttle blocks, mallets, mauls, etc., are cut under very similar conditions and thus are subject to similar attack, and the protective measures described in this bulletin are equally applicable to stock cut for such purposes. Those woods which are probably most subject to insect attack and subsequent damage, if cut during certain seasons of the year, as explained on pages 14 and 15, are hickory, pine, persimmon, spruce, ash, and dogwood, although the others mentioned are by no means immune. The damage can be largely prevented if proper measures are taken.

From the standpoint of durability cedar, juniper, and white oak are probably the most desirable of the woods listed above, especially where the wood comes in contact with the ground.[1]

FIGURE 1.—An adult bark beetle, *Ips avulsus* Eich. Enlarged 18 diameters

CLASSES OF INSECTS RESPONSIBLE AND THE DAMAGE THEY DO

The insects responsible for damage, in cases where the bark remains on logs used in rustic work, can be conveniently grouped into three main types or classes, according to their structure and the character of their work, namely, bark beetles,[2] ambrosia beetles,[2] and wood borers.[3] The bark beetles confine their activities to the bark and burrow between it and the sapwood, often scoring the latter, the ambrosia beetles bore directly through the bark into the sapwood and sometimes the heartwood, and the wood borers may penetrate all three parts of the log.

All three classes of these insects have four distinct stages, namely, the egg; the larva, also called worm or grub; the pupa, or transforming stage; and the adult, or beetle stage. Only the larval and adult stages are responsible for damage to woodwork.

In all instances the larvae hatch from eggs laid by the beetles. After the larva becomes mature it makes a cell in which to rest, called the pupal cell, and there becomes a beetle.

BARK BEETLES

The adult insects of the first class, the bark beetles, are short, cylindrical, reddish-brown to black insects, varying in length from about one-sixteenth to one-fourth inch. (Fig. 1.) They bore

[1] The United States Forest Service has conducted extensive tests and made detailed studies of the durability and chemical preservation of wood and should be consulted if further information of this character is desired.

[2] Order Coleoptera, family Scolytidae.

[3] Order Coleoptera, families Cerambycidae, Bostrichidae, and Buprestidae.

through the outer bark to its soft inner portion, called the phloem, where they make tunnels of various types, along the sides of which they lay their eggs. (Fig. 2.) It is while the beetles are boring through the bark and constructing their tunnels that they push out to the entrances the fine brownish-white sawdustlike particles, or frass, which falls on the wood below and attracts attention by its unsightly appearance, and it is this tunneling that causes the bark

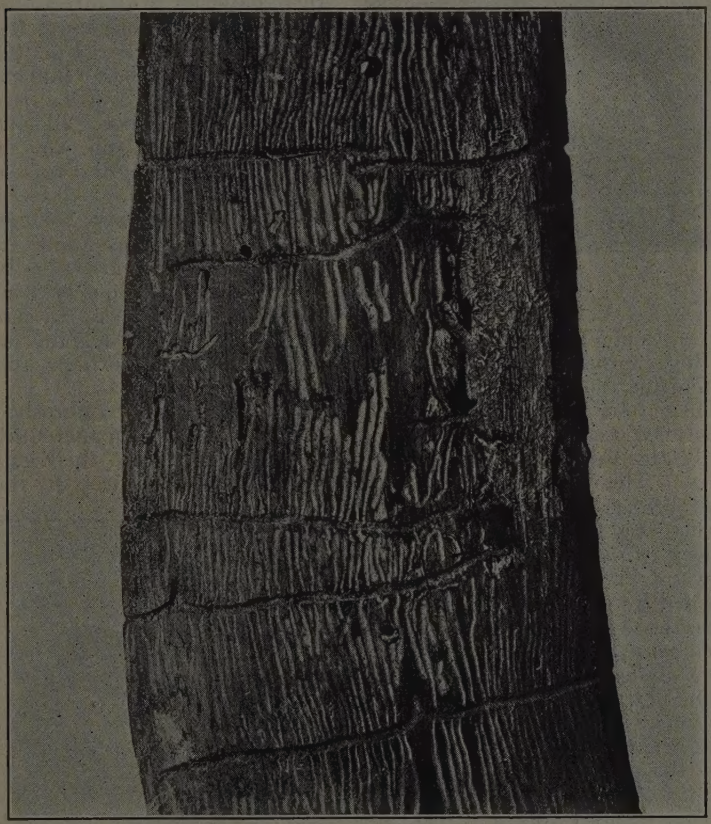

FIGURE 2.—Tunnels of adults and larval galleries of a bark beetle, *Leperisinus aculeatus* Say, beneath the bark of ash. Natural size. The frass that was in the galleries of this species adhered to the bark when it was removed

to loosen and fall off. The piles of frass on a log enable one readily to detect the presence of bark beetles within it. The larvae or grubs are tiny, whitish, cylindrical, slightly curved, legless creatures. (Fig. 3.) Upon hatching from the eggs, they extend their mines in all directions, quite often at right angles to the original (parent) tunnel, thereby aiding in the loosening of the bark. The galleries often contain borings or frass. This depends upon the species of bark beetle.

AMBROSIA BEETLES

The ambrosia beetles (fig. 4) or pinhole borers, which are the adults of the second class, closely resemble the bark beetles in general appearance. Their work differs considerably, however, and can easily be distinguished. After the ambrosia beetles enter the bark they bore immediately into the sapwood and sometimes into the heartwood, where they extend their galleries in all directions, each making a hole about the size of a pinhead. (Fig. 5.) While boring these tunnels they push out sawdustlike particles, which either fall out loosely in piles (fig. 6), or come out in stringlike masses (fig. 7) as if being squeezed from a tube. These borings are white, whereas those of the bark beetles are usually brownish and fall loosely from the holes in the bark. In certain cases much of it, however, remains in the tunnels. The galleries of the ambrosia beetles are round, always free from borings, and quite often their walls are stained black.

FIGURE 3.—Larva or grub of a pine bark beetle (*Ips* sp.). Enlarged 10 diameters

Their food is not the wood, but a substance called "ambrosia," which is a coating formed of a minute fungus that is propagated by the beetles themselves. It is this that stains the walls of their galleries.[4] The damage by these borers is caused almost entirely by the adult beetles, as the larvae, until mature, stay either in the original gallery or in separate cells where they are in most cases cared for and fed by the beetles.

FIGURE 4.—An adult ambrosia beetle (*Xyleborus* sp.). Enlarged about 14 diameters

Beetles of this group do not often cause much damage to wood after it has been put into log cabins or rustic work if the trees are cut in the fall of the year, because then it has seasoned by the time the beetles are flying and is too dry to be in a suitable condition for them to work in it. If the wood is cut green, however, and is used during the period of insect activity, it may be attacked immediately by the beetles, in which case a considerable quantity of boring dust will be exuded.

WOOD BORERS

The adults of the wood borers do not as a group present so uniform an appearance as do the bark beetles and ambrosia beetles. The

[4] HUBBARD, H. G. AMBROSIA BEETLES. U. S. Dept. Agr. Yearbook 1896: 421–430, illus. 1897.

FIGURE 5.—Work of adult ambrosia beetles (*Xyloterus* sp.) in pine. Two-thirds natural size

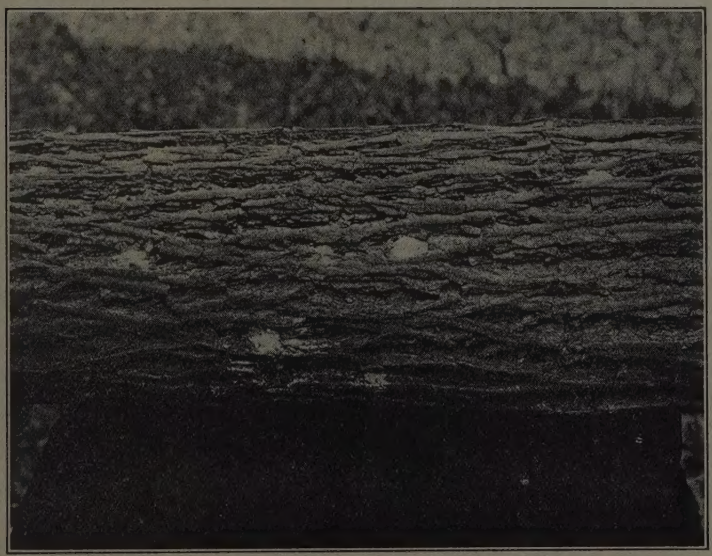

FIGURE 6.—Piles of boring dust or frass being pushed out as ambrosia beetles (*Gnathotrichus* sp.) are entering a hickory log. About one-third natural size

wood borers may be divided into three subgroups, namely, powder-post beetles, roundheaded borers, and flat-headed borers.

FIGURE 7.—Boring dust or frass which certain species of ambrosia beetles (probably a species of Xyloterus) push out of the wood in cylindrical casts. About natural size

POWDER-POST BEETLES

The powder-post beetles are short, cylindrical, reddish-brown to black, hard-shelled insects, ranging in length from one-eighth to nearly one-half inch.

In the eastern section of the United States there is only one species [5] that causes much damage to the class of materials under consideration. This beetle has reddish-brown markings and is about one-fourth of an inch long. (Fig. 8.) It is commonly known as the "red-headed shot-hole borer" and was mentioned years ago by C. V. Riley as doing considerable damage. It works principally in the wood of the hickory and persimmon, although it has been found in other woods. The adult bores through the bark and into the sapwood, making a cylindrical tunnel around the log just under the surface of the wood and at right angles to the grain. (Fig. 9.) The pores or cells of the wood are opened up, and the female beetle can then insert her eggs into them. The original or egg tunnel is usualy bored about 1½ inches on each side of the entrance hole, although in some cases it may extend in one direction only. The injury can readily be detected by the loose, whitish, dustlike borings which may be found on the bark below the circular entrance hole of the parent gallery.

The larva or grub of this beetle has a curved form, somewhat similar in shape to that of the cutworms found in the garden. When it is doubled up the head of the grub is close to the end of the abdomen. (Fig. 10.) This beetle, in marked contrast to the ambrosia beetles, is exceedingly destructive to the wood, both in its adult and larval stages. In pieces of wood of small diameter it often extends its gallery or tunnel completely around the section, thus

FIGURE 8.—An adult powder-post beetle, *Xylobiops basilare*. Enlarged 12 diameters

[5] *Xylobiops basilare* Say.

greatly weakening it and causing it to break off readily. The larvae also extend their work to the pith in such pieces, completely destroying it and often literally reducing it to powder. In the larger pieces of wood this insect confines its work more to the sapwood, and by the time the larvae are full grown they have destroyed nearly all of the sapwood. (Fig. 11.) The work of the larval borers is entirely in the interior of the log and can not be detected without chopping into the wood. The borings are of the same texture as those of the adult ambrosia beetles but are packed tightly in the mines behind the larvae. When the borings are loosened they break up into cakes. Occasionally the injury is not noticed until the wood has been worked up into the finished product (fig. 12) and the emerging beetles leave holes that indicate the destruction which has been going on unnoticed inside of the manufactured article.

Hickory and persimmon woods used in the manufacture of shuttle blocks, mallets, mauls, etc., are liable to severe injury by this insect, sometimes suffering a 50 per cent loss. (Figs. 11 and 12.)

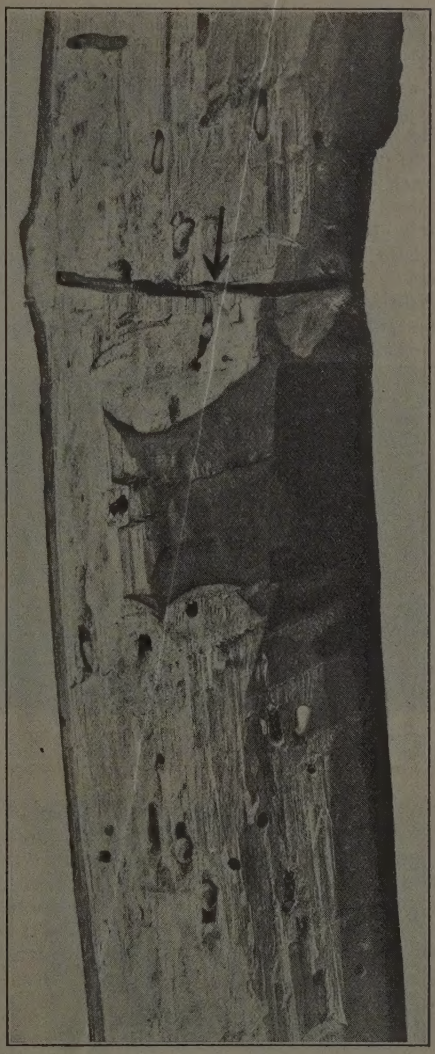

FIGURE 9.—Piece of hickory with the bark and a little of the wood removed, revealing tunnel of an adult powder-post beetle, *Xylobiops basilare*. Entrance hole is shown at tip of arrow, and the gallery is seen extending on each side. Larvae, pupae, and emerging adults are shown in their cells. Natural size

ROUNDHEADED BORERS

The roundheaded borers have a remarkable variation in general appearance. (Fig. 13.) The beetles range in length from less than one-fourth inch to more than 1½ inches. They also vary considerably in the place and the manner of laying their eggs. The adult beetles lay their eggs (1) on top of the bark[6] (fig. 14), or (2), if the bark is

[6] *Chion cinctus* Drury.

removed, occasionally on the sapwood, over which they secrete a covering, or (3) in crevices under the bark [7] (fig. 15), or (4) through slits or pits [8] which they gnaw in it. (Fig. 16.)

The larvae (fig. 17) which hatch from these eggs are entirely responsible for the damage caused to the wood. They are elongate, fleshy, yellowish-white grubs, usually slightly tapering toward the tail end. Upon hatching, they bore into the soft layers of the inner bark, or phloem, which they begin to mine. Some species [9] confine much of their activity to mining under the bark, thereby loosening it and causing it to fall off, and they also mine in the outer sapwood. (Fig. 18.) Others make large oval mines which extend deeper into the sapwood [10] and heartwood.[11] Sometimes the grubs completely riddle the wood within a few months, although one species [11] has entirely different habits and may continue its destructive work in the seasoned wood over a period of several years. As these galleries are often one-half inch wide and as much as 2 feet long, they weaken the material as well as cause an unsightly condition because of the large quantity of boring dust which many of the grubs push to the outside during the process of excavation. (Fig. 19.)

FIGURE 10.—Larva or grub of the powder-post beetle *Xylobiops basilare*. It is in this stage that it does most of its injurious boring. Enlarged 9 diameters

Each species differs somewhat from others in the method of preparing its gallery. Some grubs pack the borings, or frass, tightly behind them (fig. 11), while others push it out through the entrance hole (fig. 19). The composition of these borings varies from fine, white, and powdery material (fig. 11) to coarse, brownish particles (fig. 19) or shreds of wood fiber (fig. 20). These characters, combined with the species of wood they select to work in, make it possible to determine the type of injury, and in most instances to identify the specific insect responsible for the damage, since each species makes a different pattern while scoring the wood under the bark or gallery of a different shape or size while working in the wood.

FLAT-HEADED BORERS

The beetles of the group known as flat-headed borers are more uniform in general appearance than are those of the roundheaded borers. They are slightly flattened, metallic-colored, boat-shaped beetles which range in length from one-fourth inch to nearly 1¼ inches. (Fig. 21.)

[7] *Neoclytus* sp., *Cyllene caryae* Gahan, etc.
[8] *Monochamus* sp.
[9] *Xylotrechus colonus* Fab. and *Callidium antennatum* Newm.
[10] *Neoclytus* sp., *Monochamus* sp., *Cyllene caryae* Gahan.
[11] *Hylotrupes bajulus* L.

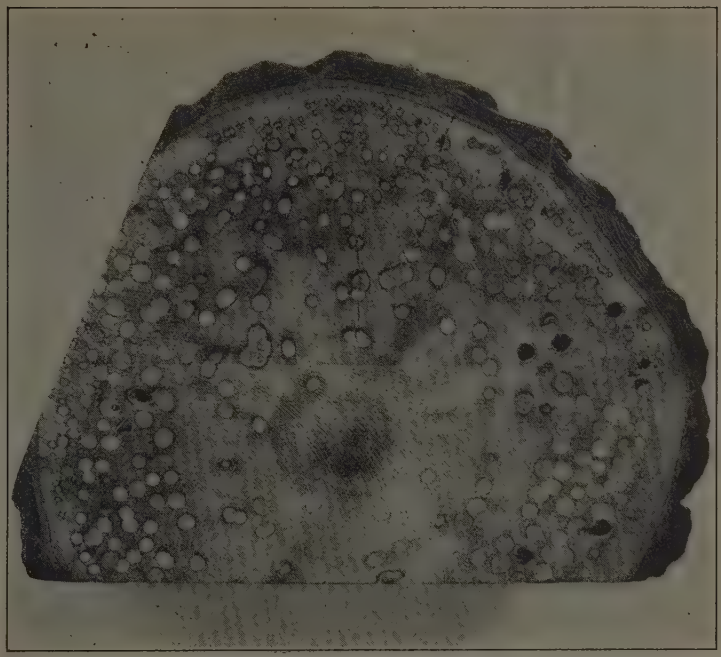

FIGURE 11.—Cross section of persimmon log, showing the wood destroyed by grubs of the powder-post beetle *Xylobiops basilare*. Natural size

The eggs are laid singly or in a mass on the bark or in crevices in the bark or wood. The larva is an elongate, depressed grub having a characteristic flat head often wider than the rest of the body. (Fig. 22.) The young borer mines the inner bark or the wood, making a flattened, oval, more or less tortuous mine or wormhole which, when completed, widens into a large pupal or resting cell. This connects with the outer surface by a short, oval exit hole through which the new beetle emerges after the larva has transformed and matured in the pupal cell. The larval mines may be in either the bark or wood alone, or, as in many instances, extend throughout the entire piece,[12] and are filled with tightly packed sawdustlike material. (Fig. 23.)

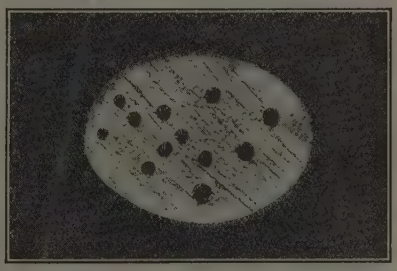

FIGURE 12.—Cross section of hickory handle, showing damage caused by grubs of the powder-post beetle *Xylobiops basilare*. Some of the tightly packed powderlike borings were removed from near the surface to show more clearly the extent of the damage. About actual size

[12] For further and more detailed information, see BURKE, H. E. FLAT-HEADED BORERS AFFECTING FOREST TREES IN THE UNITED STATES. U. S. Dept. Agr. Bull. 437, 8 p., illus. 1917.

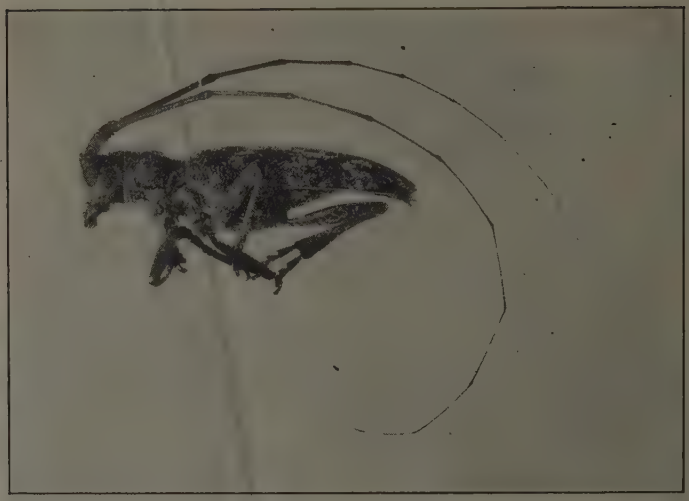

FIGURE 13.—Adult beetle of southern pine sawyer, *Monochamus titillator* Fab. Enlarged 2½ diameters

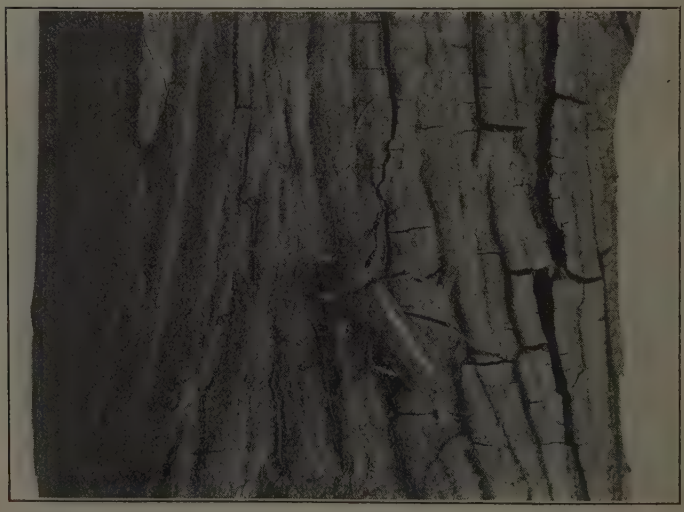

FIGURE 14.—Adult female beetle and egg of *Chion cinctus* on a section of hickory. About natural size

SEASONAL ACTIVITY OF THE INSECTS

Some, at least, of the insects of the kinds previously mentioned are at work during the entire growing season, which lasts from April

FIGURE 15.—Piece of log with bark removed to show eggs of white painted hickory borer, *Cyllene caryae*, which were inserted through crevices. Enlarged 3½ diameters

to October in the vicinity of Washington, D. C., from February to December in the extreme Southern States, and from May to September in the Northeastern States. During this time beetles are active, looking for favorable woods on which to lay their eggs. During the rest of the year, however, certain species of these insects are relatively inactive and only a very few or no adult beetles are present.

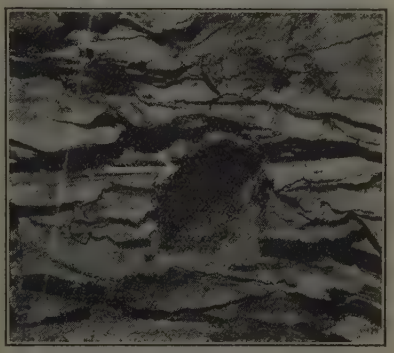

FIGURE 16.—Egg scar made by southern pine sawyer, *Monochamus titillator*, on bark of pine. The eggs are inserted through this opening. About natural size

The bark beetles and ambrosia beetles are active throughout nearly the entire period within the months specified although their numbers vary a great deal within the season of activity. Insects of both the bark-beetle and ambrosia-beetle types mature very rapidly and can develop from the egg to the adult stage in from four to six weeks. They may have as many as three and often five generations a year in certain parts of the South.

The wood borers are not active for so long a period during the season as are the other two classes of beetles and do not multiply so rapidly. Many of them have one generation a year, and others have only one every two years.

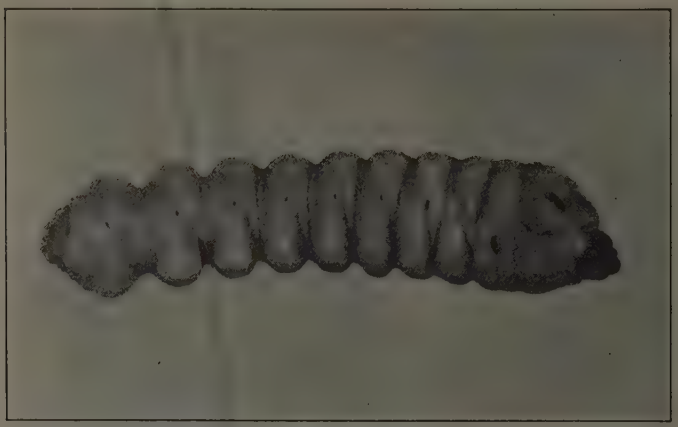

FIGURE 17.—Larva or grub of a roundheaded borer, *Megacyllene antennatus* White. Enlarged 3 diameters

The powder-post beetle that is most destructive flies in the vicinity of Washington, D. C., mainly from the early part of May to the middle of June, the maximum emergence taking place between May 30 and June 8. Occasionally a partial second generation occurs, and a few beetles emerge during the warm days of late summer and fall and may be seen in flight from August 15 until cold weather comes. The main brood survive the winter in the mature larval stage and do not emerge as beetles until the following May. Seasonal differences affect the earliness or lateness of the flight period. During the hottest part of the summer it is possible for the beetles to develop from eggs in from 60 to 70 days.

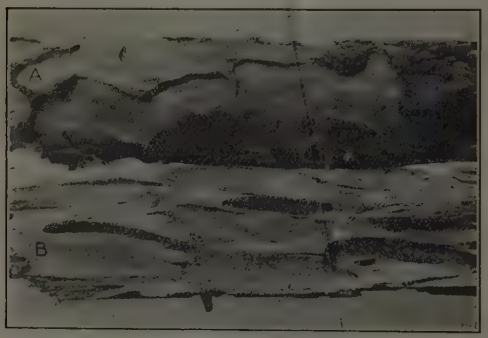

FIGURE 18.—Larval mining of a roundheaded borer, *Callidium antennatum*, which causes the bark to fall off: A, outside of the piece; B, inner mines of the borer. One-half natural size

The beetles of the roundheaded borers usually fly only a few weeks during the spring and summer months, in the vicinity of Washington, D. C., where they have only one generation a year. Farther

FIGURE 19.—Boring dust exuded by the grub of *Cyllene caryae* as it mined in the sapwood of hickory. About one-sixth natural size

FIGURE 20.—Coarse shredded frass made by the grubs of the southern pine sawyer, *Monochamus titillator*, a roundheaded borer. Enlarged about 2 diameters

south some species have two generations and sometimes a partial third.

The flat-headed borers, as beetles, fly about the same time that those of the roundheaded borers appear. Some species mature in a year; others take as long as two years.

CONDITIONS FAVORABLE AND UNFAVORABLE FOR ATTACK

The kind and condition of wood attacked are largely dependent upon the species of insect. Some species prefer freshly cut wood that is in a moist condition, others partly seasoned wood, and still others require wood that is dry and well seasoned.

FIGURE 21.—Adult beetle of a flat-headed borer, *Chrysobothris octocola* Lec. Enlarged 4 diameters

CONDITIONS FAVORABLE FOR BARK BEETLES AND AMBROSIA BEETLES

Two types of insects, the bark beetles and the ambrosia beetles, attack freshly cut logs on which the bark remains and in which the inner bark is still white and active and the sap is still present. The ambrosia beetles, however, like equally well logs, with or without bark, that have been submerged in water and which after being removed from the water remain in a moist condition, as when they are placed on the ground in the shade. Such logs may continue to be attacked until they dry out. Wood that is cut during the spring and summer months, when the weather is warm and damp, may be subject to severe injury, especially when placed in close piles on the ground so that it does not receive adequate ventilation. Wood which is cut in the early fall and dried out, or seasoned sufficiently during the winter months, is in an unfavorable condition for attack by bark beetles and ambrosia beetles when their active season arrives.

CONDITIONS FAVORABLE FOR POWDER-POST BEETLES

The powder-post beetles prefer wood that has been cut several months. They show a decided preference for wood that is cut either in the fall and slowly seasoned over winter, or that which is cut during the active season and dried rapidly. Occasionally they attack recently cut wood, but as a rule they are unsuccessful in establishing themselves in it.

CONDITIONS FAVORABLE FOR ROUNDHEADED BORERS AND FLAT-HEADED BORERS

Conditions that invite attack by roundheaded and flat-headed borers vary considerably. Many borers prefer recently cut logs, whereas other borers attack logs which have been seasoned for several months. The manner of handling the logs after they are cut has a decided influence upon whether they will ultimately be attacked. As each species of these beetles flies and lays its eggs during only a short period, and as each kind attacks only one or two kinds of wood, which must be in just the right condition to attract it, the danger of attack by any particular kind is relatively small.

FIGURE 22.—Grubs of the flat-headed borer *Chalcophora angulicollis* Lec. Enlarged 2 diameters

PREVENTIVE AND CONTROL MEASURES

Methods of preventing insect attack and the checking of subsequent injury, once the log is infested, depend largely upon the seasonal history and habits of the insects involved. By taking advantage of what is known of these, the desired protection can be obtained.

PREVENTION OF ATTACK

SEASONAL CUTTING FOR RUSTIC STRUCTURES

The logs with the bark remaining on them and poles used in the construction of rustic cabins, summer houses, fences, etc., should be cut in October or November and piled

at once,[13] either off the ground or under cover, in such a manner as to offer the best facilities for the rapid and thorough drying of the inner bark before the beetles begin to fly in the spring.[14] This will in almost every case prevent their being damaged by the insects that prefer the freshly cut wood.

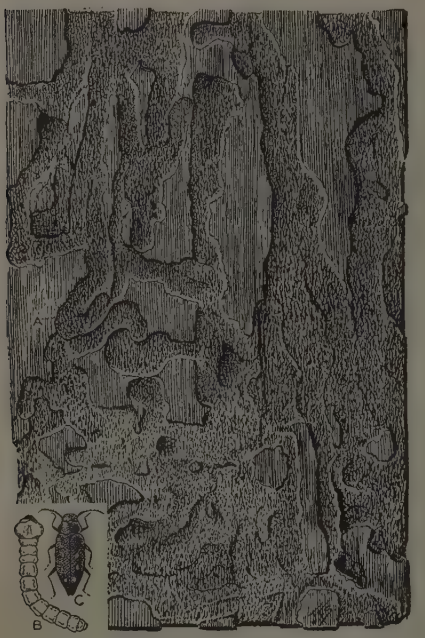

FIGURE 23.—Work of the flat-headed eastern hemlock bark borer, *Melanophila fulvoguttata* Harr. A, section of hemlock bark showing larval mines in the inner portion, one-half natural size; B, larva; C, adult, natural size. (Burke)

FOR MANUFACTURED PRODUCTS

To prevent injury to poles used in the manufacture of rustic furniture, shuttle blocks, mallets, and mauls, the wood should be handled in the following manner:

Restrict the cutting, as previously recommended, to the late fall and winter months, and either utilize the wood before the first flight of beetles occurs in the spring or place it under a closed cover where it will be protected from insect attack. In some cases screening may have to be resorted to, screen cloth having 18 meshes to the inch being used.

If cutting is necessary during the spring and summer months, remove the poles from the forest as fast as they are cut and utilize them at once. A few days' exposure in the forest at this time is sufficient for infestation to occur which may develop after the wood has been manufactured into the finished product. (Fig. 12.) If the poles can not be moved at once, they can be protected for several days by being sprayed with a solution of creosote and kerosene as hereafter described.

Avoid leaving about the factory yards, during the period of insect activity, waste material on which the bark remains, as it is likely to serve as a breeding place for the insects.

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[13] Juniper, or cedar, trees can be felled during August with very little danger of attack if the tops are removed and the poles are laid singly on the ground and turned over once a week for about three weeks to expose a fresh surface to the sun.

[14] HOPKINS, A. D. INSECT INJURIES TO FOREST PRODUCTS. U. S. Dept. Agr., Bur. Ent. Circ. 128, 9 p. 1910.

TREATING WITH CHEMICALS

Certain powder-post [15] and roundheaded [16] borers can not always be readily controlled by such measures, and to obtain the maximum protection the wood used in the construction of rustic cabins, summer houses, etc., should be treated in the spring, before the first flight of the beetles occurs, with either crude pyridine or coal-tar creosote. These liquids are effective when diluted with kerosene in the proportion of one part of pyridine or coal-tar creosote to three parts of kerosene. Methods of applying these liquids are discussed on pages 18 and 19.

Whenever it is necessary to cut trees for these purposes during the spring and summer months, while the insects are active, and it is desired to retain the bark on the logs, the logs should be treated, as soon as cut, with one of the chemicals just mentioned. Where a slight staining of the wood is objectionable, the same protection can be obtained by carefully removing the bark in sections, applying the solutions to the sapwood, and then replacing the bark, using large-headed nails to fasten the bark in place. One nail to each square foot is usually sufficient for this purpose.

Pyridine.—Crude pyridine is a colorless, nearly stainless liquid, and possesses a strong disagreeable odor. Because of this odor, logs or furniture should be treated in the open some distance from any dwelling. If it is necessary to apply this chemical inside a building, the doors and windows should be opened so as to allow ventilation. A windy day would be preferable. Pyridine is inflammable, and reasonable care should be taken in handling it, especially where the wood treated is overhead (rafters, etc.), since the liquid dripping down might burn the skin slightly and be especially painful if it came in contact with the eyes.

Creosote.—Coal-tar creosote (grade 1, liquid oil) is a dark-brown liquid which stains the bark deeply when applied full strength. When diluted with three parts of kerosene, however, the bark is stained only slightly, and this gives a rather pleasing effect. The odor is not very strong when the creosote is diluted with kerosene. Before it is used it should be strained through burlap, and only a good grade of creosote should be used, the kind recommended above; otherwise the wood may be stained darker than is desirable.

PEELING THE POLES

Where it is not especially desirable to retain the bark, a very pleasing effect can be obtained by peeling the poles and treating them with creosote and kerosene in the proportions suggested above. The slight stain thus given is just deep enough to give to a cabin a rustic effect which usually is agreeable. The advantage of this method is that the wood can be cut at any time of the year and yet will not be injured by insects. Furthermore, the creosote aids in preserving the wood. In certain localities, peeling the poles and logs is quite

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[15] *Xylobiops basilare.*

[16] *Callidium antennatum* in pine, *Callidium janthinum* Lec. in cedar, and *Chion cinctus* in hickory and oak.

popular. The peeled poles, however, should be kept off the ground for several days or until they have had a chance partially to season so that they will not be attractive to pinhole borers. Peeled poles thus seasoned will not need treatment with chemicals to protect them from insects.

TREATMENT AFTER ATTACK

KILLING THE INSECTS WITH CHEMICALS

Since it is not always possible to prevent injury by taking the precautions just described and because the greater part of the damage is often done before its discovery, investigations were undertaken to find a substance which will serve as an effective remedy. The results of this investigation proved that both liquid orthodichlorobenzene [17] and crystalline paradichlorobenzene are effective.

Crude orthodichlorobenzene.—The crude orthodichlorobenzene product is a colorless, stainless liquid and possesses a slight odor. It is noninflammable, but it is slightly poisonous, and the odor might cause a headache if the liquid were handled for an hour or so at a time. The same precautions should be taken in handling it that are recommended in connection with handling pyridine. It should be applied full strength.

Paradichlorobenzene.—Paradichlorobenzene, which has recently proved effective in the control of the peach-tree borer,[18] was found most effective when prepared, as for the preventive treatments, by being dissolved in three parts, by weight, of kerosene. Care should be taken to dissolve all of the crystals. It is noninflammable and only very slightly poisonous. Both of these solutions slowly liberate a gas which kills the insects. This chemical, like orthodichlorobenzene, may destroy the finish on furniture and necessitate revarnishing. If the infested wood is not treated it will eventually be destroyed.

SUGGESTIONS FOR APPLYING THE CHEMICALS

Wood, before being utilized, can be treated easily and efficiently by being dipped into the solution so that it will penetrate all cracks, crevices, and bark sufficiently to reach the insects and kill them. A trough can be made by bending up the sides and ends of a sheet of some metal, such as galvanized iron, to conform roughly to the shape of the log to be treated. The solution should be poured into the trough and the log immersed. A piece of cord or rope placed under the log will aid in rolling it so that all surfaces will be covered in the course of treatment. After being treated, the wood should be laid in a sunny place to dry.

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[17] The chemical purchased under this name (also called orthodichlorbenzol) and tested as such against insect attack, as well as most other products on the market to-day which are being sold for this purpose in the place of orthodichlorobenzene, is mainly a liquid which might be called a crude chlorinated benzol product and is not the pure orthodichlorobenzene. The crude product is manufactured by several concerns, each using its own method, and is being sold under different trade names. It is usually composed largely of monochlorobenzene and ortho-, meta-, and paradichlorobenzene products with the greater part of ortho in it. The pure orthodichlorobenzene is manufactured in limited quantities at the present time and is very expensive; in fact, too expensive to be used for this purpose.

[18] BLAKESLEE, E. B. USE OF TOXIC GASES AS A POSSIBLE MEANS OF CONTROL OF THE PEACH-TREE BORER. U. S. Dept. Agr. Bul. 796, 23 p., illus. 1919.

SNAPP, O. I., and ALDEN, C. H. PARADICHLOROBENZENE EXPERIMENTS IN THE SOUTH FOR PEACH-BORER CONTROL. U. S. Dept. Agr. Tech. Bul. 58, 40 p., illus. 1928.

Wood in use can be conveniently treated by applying a liberal quantity of one of the foregoing chemicals,[19] either with a good spraying apparatus or with a brush. To insure the best results it is important to treat thoroughly all parts of the wood. One gallon of the solution of paradichlorobenzene in kerosene or of the crude orthodichlorobenzene is sufficient to treat five logs, each 10 feet long and 4 inches in diameter, or approximately 50 square feet of bark surface. Two gallons will saturate approximately 100 square feet of wood surface. A pint is usually sufficient to treat a rustic chair of ordinary size.

KILLING THE INSECTS WITH HEAT

In the manufacture of rustic furniture it is customary to steam the wood prior to bending it, especially the older pieces of small-dimension hickory. Quite often the material is found to be infested by the previously mentioned types of borers, and it is usually supposed that by leaving the wood in water, through which steam is being passed, for a period of 15 to 30 minutes, the borers will be killed. An examination of material in a factory where the foregoing method was used in the manufacture of rustic furniture from hickory demonstrated that only a very small percentage of the grubs are killed in this short period of time.

Results of tests [20] have shown that it is necessary to subject infested hickory and ash to kiln temperatures of 125° to 130° F. for a minimum period of 1½ to 2 hours after the wood has been brought up to the initial temperature in order to kill all of the grubs in wood 1 inch thick.

Fisher,[21] in verifying the foregoing experiments for the control of Lyctus beetles, determined the period of time necessary for wood of various thicknesses to reach this initial temperature, when infested ash and oak are placed in a cold kiln and raised to the lethal temperature of 130° F. In addition to this period a safety factor of one-half hour is added. Following this the wood is subjected to live steam for 1½ to 2 hours in a saturated atmosphere. The schedule is as follows:

Thickness of timber	Temperature required	Time required to overcome lag after kiln has attained 130° F.	Additional safety factor	Time then held at 130° F.	Total period in kiln at 130° F.
	°F.	*Hours*	*Hours*	*Hours*	*Hours*
1 inch	130	1½	½	1½	2½
2 inches	130	2	½	1½	4
2½ inches	130	3¼	½	1½	5¼
3 inches	130	4½	½	1½	6½

[19] Pyridine, paradichlorobenzene, and the crude orthodichlorobenzene product are manufactured by only a few chemical firms. Names and addresses of these firms will be furnished on application to the Bureau of Entomology, U. S. Department of Agriculture.

[20] CRAIGHEAD, F. C., and LOUGHBOROUGH, W. K. TEMPERATURES FATAL TO LARVAE OF THE RED-HEADED ASH BORER AS APPLICABLE TO COMMERCIAL KILN DRYING. Jour. Forestry 19: 250–254. 1921.

SNYDER, T. E., and ST. GEORGE, R. A. DETERMINATION OF TEMPERATURES FATAL TO THE POWDER-POST BEETLES, LYCTUS PLANICOLLIS LE CONTE, BY STEAMING INFESTED ASH AND OAK LUMBER IN A KILN. Jour. Agr. Research 28: 1033–1038, illus. 1924.

[21] FISHER, R. C. LYCTUS POWDER-POST BEETLES. Dept. Sci. and Indus Res. [England], For. Prod. Res. Bul. 2, 46 p., illus. 1928.

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